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(56) Documents Cited
GB 1276052 A GB 0708521 A GB 0656984 A
GB 0655137 A GB 0305478 A US 4505499 A

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(54) A seal for an annulus between inner and outer pipes

(57) The seal includes a resilient member 5 and a deforming means 6, 7 for deforming the resilient member between an operative and inoperative form. The deforming means 6, 7 comprises wedge shaped profile adjacent respective faces of corresponding shape of the resilient member. The seal may be used to seal the annular region between two concentric pipes, e.g. of an underwater pipe within an outer shell pipe containing insulation.

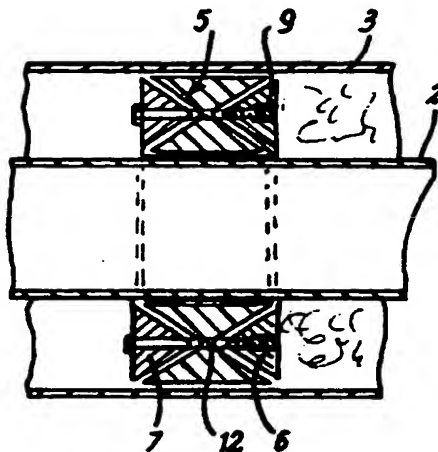
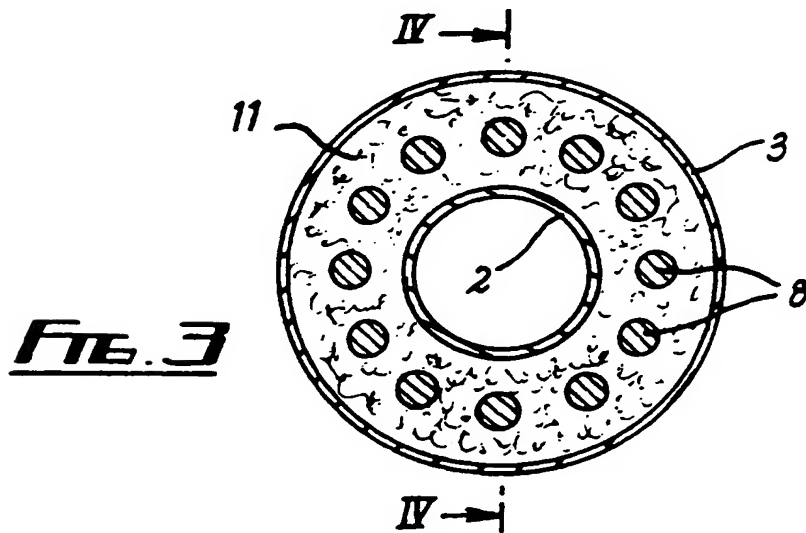
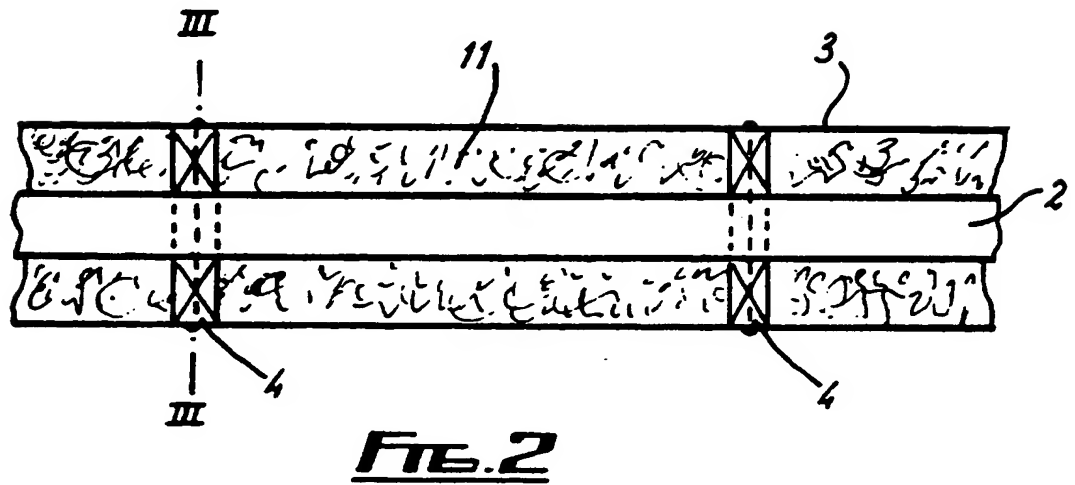
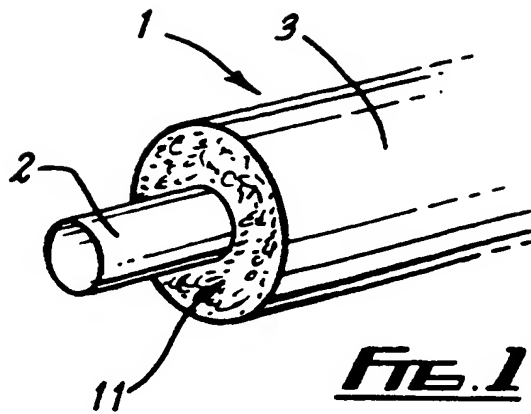


FIG. 4

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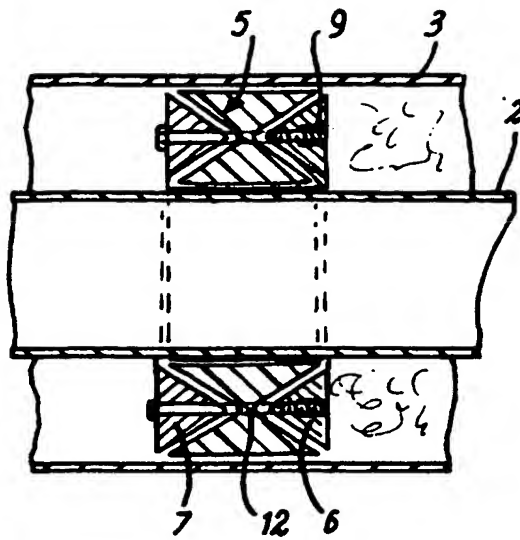


Fig. 4

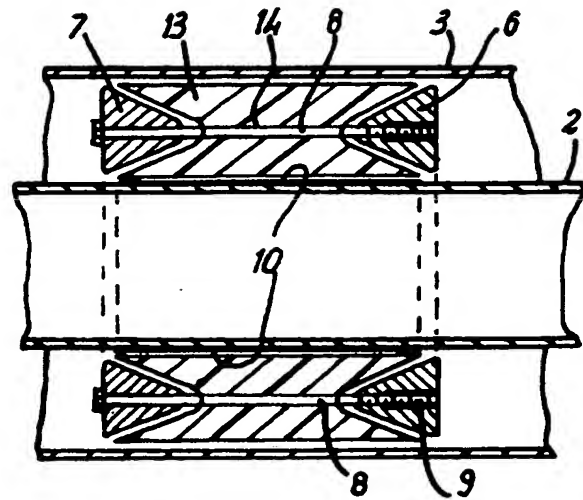


Fig. 5

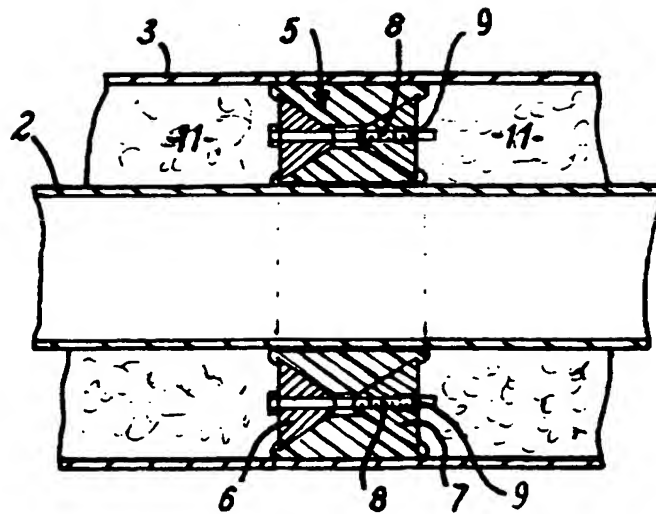


Fig. 6

A SEAL

The present invention relates to a seal. The seal is particularly but not exclusively intended for use in submerged pipelines.

Seals for submerged pipelines are known. In one arrangement in which an inner pipe is disposed coaxially within an outer pipe insulation is located in the annular gap between the two pipes. A seal is employed to fill the annular space between inner and outer pipes at opposite ends of the pipeline or section of pipeline. The seal prevents escape of the insulating material from or ingress of water into the annular space between inner and outer pipes and maintains concentricity of the pipeline, whilst allowing for variations in the dimensions of the two pipes.

In an existing arrangement in such a pipeline a seal is effected by use of an annular rubber ring, placed between two segmented annular steel plates. The two steel plates are joined by means of bolts which pass through corresponding holes made through both steel plates and the rubber ring.

The seal assembly is placed in the annular space between inner and outer pipes. To effect a seal the through bolts are tightened, drawing together the steel plates and compressing the rubber ring. The rubber ring expands radially causing it to form a seal against the outer surface of the inner pipe and the inner surface of the outer pipe.

Seals of this type require large forces to be applied by the through bolts to effect a satisfactory seal. This requirement dictates that the seal plates be of heavy gauge. The incorporation of heavy steel components into the annular space between inner and outer pipes tends to promote heat transfer. This is undesirable. Heavy steel components also add considerably to the cost of the seal.

According to the present invention there is provided a seal comprising a resilient member and means associated with the member for deforming the member from an inoperative form to an operative form, the deforming means having a wedge shaped profile adjacent the resilient member, whereby on engaging the deforming means against the member, the member is deformed from the said inoperative form to the said operative form to provide a seal.

In a preferred embodiment of the invention the resilient member has an annular shape as has the deforming means which comprises two annular rings, placed on opposite sides respectively of the resilient member, at least one and preferably both of which are of substantially triangular cross-section and therefore present a wedge shape to the resilient member. Both rings are joined together by fastenings passing through the resilient member and the deforming means. This embodiment in particular enables the seal to seal an annular space, such as is found in the gap between two concentric pipes. The resilient member is preferably made from Ethylene Propylene Dimonomer Polymer (E.P.D.M.) although it could be constructed from any other suitable material, or

combination of materials. Where the resilient member forms an annulus it is preferable that the cross-section of the annulus is shaped to accept the wedge profile of the deforming means. As such the cross section is preferably of double triangular shape. This being the shape defined by two substantially identical triangles where a first triangle is placed inverted with respect to, and directly above a second triangle and both triangles are joined at adjacent apices. The shape so defined has upper and lower parallel edges and is substantially symmetrical about both vertical and horizontal axes.

In another embodiment the resilient annulus is of double trapezoidal shape, that being defined by two substantially identical trapezia placed with their shorter parallel sides adjacent. It will be appreciated that in this alternative embodiment as the length of the shorter parallel sides of the trapezia are reduced, the cross section of the resilient annulus approaches the double triangular shape of the first mentioned embodiment.

The annular deforming wedges are preferably constructed from a plastics material e.g. glass filled nylon or polycarbonate although they could also be of metal construction e.g. steel or aluminium. It is desirable that the angle formed at the point of the wedge lies in the range 10° - 130° and the points of the wedge are curved to avoid damage to the resilient member. As such the internal angles at the base of the wedge preferably lie in the range 25° - 85° . The two annular wedges are preferably fastened together by means of bolts passing through the first deforming member, the resilient member and into the

second deforming member where they preferably engage with threaded inserts forming part of the second member. Other suitable fastening means could also be used to draw the two deforming means together, for example, using a cam action and through rods.

In order that the invention be more clearly understood two embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig.1 shows a perspective view of an insulated pipeline section;

Fig.2 shows a pipeline comprising a number of sections of the type shown in Fig. 1;

Fig.3 shows a transverse cross-sectional view taken along the line III-III of Fig.2;

Fig.4 shows an axial cross-section along line IV-IV of Fig.3 for a part of the pipeline of Fig.2 showing a pipeline seal of the type of the first embodiment;

Fig.5 shows a corresponding view to Fig.4, but showing a pipeline seal of the type of the second embodiment; and

Fig.6 shows a view corresponding to Fig.4, but where the seal has been expanded.

Referring to Figs. 1 and 2, the pipeline comprises a number of sections 1 joined end to end and is of the type used for transfer of high temperature oil and gas from offshore rigs, along the sea bed. One of the sections 1 is shown

in Fig.1 and comprises an inner pipe 2 disposed coaxially within an outer pipe 3. Both inner and outer pipes 2 and 3 are typically constructed in carbon or stainless steel. A further anti-corrosion coating may be applied to the pipe surfaces.

The inner pipe 2 is used for fluid transfer. A thermal insulating material 11 is disposed in the annular space between the inner and outer pipes. The insulating material 11 serves to minimise thermal transfer between the outer surface of the inner pipe 2 and the inner surface of the outer pipe 3. This material may be calcium silicate or glass wool or any other suitable material. The typical temperature of the fluid carried in the inner pipe 2 is high e.g. 155 °C and the typical temperature of the sea water surrounding the outer pipe 3 is low e.g. 3 °C.

The sections 1 are joined end to end by welding to form pipelines of the desired length as shown in Fig.2.

During assembly of the pipeline section 1 seals 4 are introduced at opposite ends respectively of the section 1.

The seals 4 radially fill the annular space between inner and outer pipes 2 and 3 and serve to maintain their concentricity. The seals 4 also prevent escape of insulating material from, or ingress of water into, the annular space between the inner and outer pipes located between the two seals 4 at opposite

ends of the section 1.

Referring to Figs. 3,4 and 5 each seal comprises a resilient annulus 5, in the first embodiment shown in Fig.4, 13 in the second embodiment shown in Fig.5 and two opposing annular wedges 6 and 7. The wedges are connected by bolts 8.

The resilient seal preferably comprises Ethylene Propylene Dimonomer Polymer (E.P.D.M.) or a similar thermally insulating compound capable of withstanding the temperatures experienced in the pipeline. In addition, a layer 10 of a more heat resistant material such as a fluorocarbon elastomer sold under the trade mark VITON is bonded to those surfaces of the resilient seal expected to come into contact with high temperature surfaces.

In the first embodiment, shown in Fig.4 the resilient annulus 5 is of substantially double triangular cross-section, this being the shape defined by two substantially identical triangles, where a first triangle is placed inverted with respect to, and directly above a second triangle and both triangles are joined at adjacent apices. The shape so defined has upper and lower parallel edges and is substantially symmetrical about both vertical and horizontal axes.

The resilient annulus 5 may be produced as a one piece moulding, or as separate annular mouldings of substantially triangular cross-section. Where the annulus 5 is a one piece moulding, this may comprise two sections of

substantially triangular cross-section joined by a membrane 12 which may rupture in use. The resilient annulus 5 radially fills the annular space between inner and outer pipes 2 and 3.

In the second embodiment, shown in Fig.5 the resilient annulus 13 is of double trapezoidal cross-section, this being the shape defined by two substantially identical trapezia placed with their shorter parallel sides adjacent to each other.

The resilient annulus 13 may be produced as a one piece moulding, or as separate annular mouldings of substantially trapezoidal cross-section. Where the annulus 13 is a one piece moulding, this may comprise two sections of substantially trapezoidal cross-section joined by a membrane 14 which may rupture in use. The resilient annulus 13 radially fills the annular space between inner and outer pipes 2 and 3.

The two annular wedges 6 and 7 are of substantially triangular cross-section. The internal angles formed at the base of the wedge lie in the range 25° - 85° and in this case are 72° but will vary on application.. The two wedges face each other in an axial direction and are curved to prevent damage to the resilient annulus 5 and 13 in the first and second embodiments respectively.

The two annular wedges 6 and 7 are preferably constructed by injection

moulding of a high temperature thermal insulating plastic material, glass filled nylon and polycarbonate being suitable materials.

In both embodiments wedges 6 and 7 have a number of holes, preferably twelve, made in an axial direction through the mid-point of the wedge, as determined radially, and evenly spaced circumferentially about the wedge.

The holes through both wedges 6 and 7 correspond, one wedge 7, has through holes, to accept bolts and the second wedge 6 has holes accommodating threaded inserts 9.

The two wedges are placed in opposition, on opposite sides respectively of the resilient annulus 5 in the first embodiment, 13 in the second embodiment and joined by through bolts 8 which pass through the first wedge 7, through the resilient seal and into the second wedge 6 where they engage with the threaded inserts 9.

The seal 4 is placed in the annular space between inner and outer pipes 2 and 3 to be sealed, with the bolt heads 11 facing to the outside.

To effect a seal the bolts are tightened, so as to draw the two annular wedges 6 and 7 together. In both the first and second embodiments this causes the wedges to exert pressure on the resilient annulus in an axial direction. The annulus is forced to expand in a radial direction and may also be

moved in a radial direction, by the action of the wedges, forming seals between the outer surface of the inner pipe 2, inner surface of the outer pipe 3 and opposing wedge surfaces as shown in Fig.6.

Where the resilient annulus 5 in the first embodiment and 13 in the second embodiment is constructed to include a membrane 12 and 14 respectively in the two embodiments, this may rupture when the bolts are tightened.

It will be appreciated that the above embodiments have been described by way of example only and that many variations are possible within the scope of the invention.

CLAIMS

1. A seal comprising a resilient member and means associated with the member for deforming the member from an inoperative form to an operative form, the deforming means having a wedge shaped profile adjacent the resilient member, whereby on engaging the deforming means against the member, the member is deformed from the said inoperative form to the said operative form to provide a seal.
2. A seal according to claim 1, wherein the resilient member is of annular shape.
3. A seal according to either claim 1 or 2, wherein the resilient member is shaped to accept the wedge shaped profile of the deforming means.
4. A seal according to any preceding claim, wherein the deforming means comprises two annular rings.
5. A seal according to claim 4, wherein the deforming means are joined together by fastenings which pass through the resilient member.
6. A seal according to claim 5, wherein the fastening means comprises bolts.

7. A seal according to any preceding claim, wherein the resilient member comprises Ethylene Propylene Dimonomer Polymer (E.P.D.M).
8. A seal according to any preceding claim, wherein the deforming means are formed from a plastics material.
9. A seal substantially as herein described with reference to Figures 2,3,4 and 6 or to those figures with the modification shown in Figure 5 of the accompanying drawings.



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Claims searched: 1-9

Examiner: Roger Binding
Date of search: 5 January 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): F16L 3/12, 7/00, 7/02, 21/04, 55/132

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1276052 A (O'BRIEN)	1-3
X	GB 0708521 A (AVIMO)	1-3
X	GB 0656984 A (NOBLET)	1-3
X	GB 0655137 A (DAWES), see especially Fig 4.	1-4
X	GB 0305478 A (MULLER), see especially Fig 3.	1-3
X	US 4505499 A (UGLOW), see especially Fig 7, column 7, line 38, column 8, lines 33 to 42, and column 9, lines 22 to 28.	1-6, 8

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.